



Summer 2005 meeting

★ ★ **Tni** Europe

Technology and Innovation

& University of Brest (UBO)
& Ellidiss Technologies



Contents

- AADL support with Stood 5.0
- AADL dissemination actions
- AADL performance analysis with Cheddar

<http://beru.univ-brest.fr/~singhoff/cheddar>

<http://www.tni-world.com>

Stood-AADL

status

- Current distribution of Stood 5.0
 - released in May 2005.
 - includes AADL 1.0 import and export features.
 - download: <http://www.tni-world.com>
 - runs on Windows, Solaris & Linux
- Available support:
 - Stood-AADL User Manual (included in distrib)
 - Stood 5 Getting Started Tutorial
 - Examples
 - Hot-line and on-site training course
 - Tool customization (including AADL mapping)

Stood-AADL

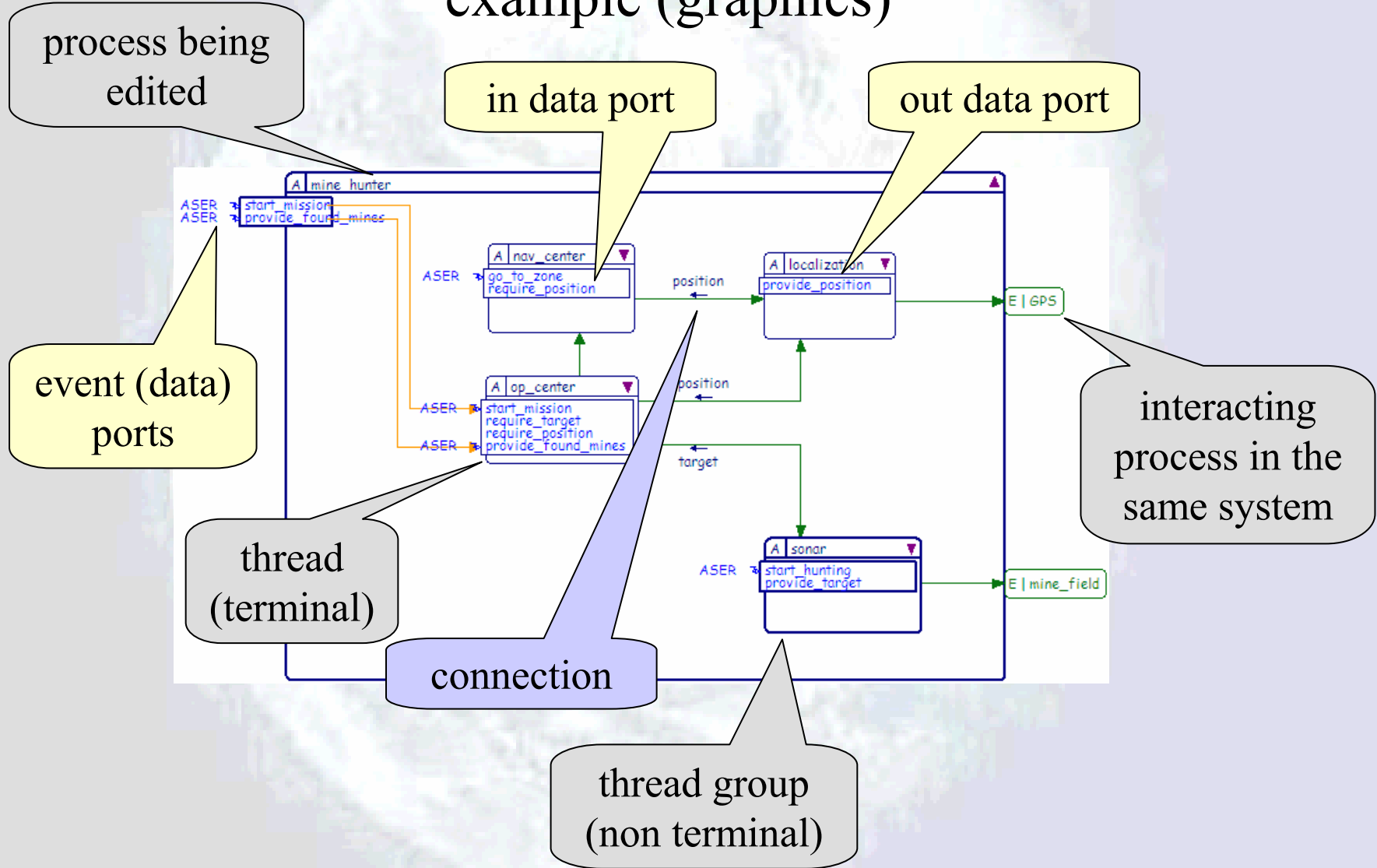
strong points

- the first supported AADL commercial tool
- well defined step-by-step modeling process:
 - capture of functional and non-functional requirements
 - graphical design of the architecture (UML 2.0 & HOOD)
 - multi-language detailed design and coding (Ada, C, C++, ...)
 - static design verifications
 - code and documentation generators
 - reverse engineering (i.e. Ada -> AADL)
- ready for industrial projects:
 - multi-users
 - configuration management
 - requirements traceability
 - Unix-Windows interoperability
 - many customizable features

Stood-AADL mapping (part of)

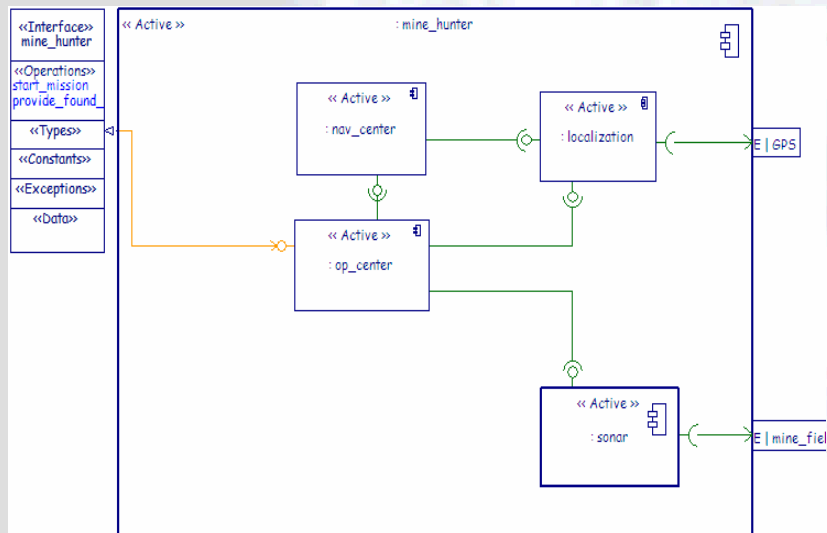
- Stood System:
 - the full SW project.
 - an AADL **System** instance + AADL **Packages**
 - a set of Stood Designs.
- Stood Active Design:
 - one executable SW application in the project.
 - an AADL **Process**
 - the root of a hierarchy of **Thread Groups** and **Threads**
- Stood Passive Design:
 - one SW library of classes (or types) used by the project
 - an AADL **Package**
 - the root of a hierarchy of child **Packages** and **Data**

Stood-AADL example (graphics)



Stood-AADL

UML view & generated AADL code



```

SYSTEM mine_hunting
END mine_hunting;

SYSTEM IMPLEMENTATION mine_hunting.others
SUBCOMPONENTS
  mine_hunter : PROCESS mine_hunter;
  mine_field : PROCESS mine_field;
  on_shore_center : PROCESS on_shore_center;
  GPS : PROCESS GPS;
END mine_hunting.others;

PROCESS mine_hunter
FEATURES
  start_mission : IN EVENT PORT;
  target : OUT EVENT DATA PORT data_types::localized_target;
END mine_hunter;

PROCESS IMPLEMENTATION mine_hunter.others
SUBCOMPONENTS
  sonar : THREAD GROUP sonar;
  op_center : THREAD op_center;
  nav_center : THREAD nav_center;
  localization : THREAD localization;
CONNECTIONS
  EVENT PORT start_mission -> op_center.start_mission;
  EVENT DATA PORT op_center.target -> target;
  DATA PORT sonar.mine -> op_center.mine;
  DATA PORT localization.pos -> op_center.pos;
  DATA PORT localization.pos -> nav_center.pos;
END mine_hunter.others;
  
```

Stood-AADL

next steps

- Improve the AADL import/export thanks to tool evaluations feedback
- More documentation, tutorials, examples ...
- Implement the AADL graphical notation:
 - a first prototype for next AADL meeting ?
 - a tool release for end 2005 or beg. 2006
- Implement the XML/XMI textual notation
- Improve model verification features:
 - performance analysis with Cheddar
 - implementation of the COTRE annex
 - complete the embedded AADL legality rules checker
- + satisfy requirements of projects using AADL

AADL

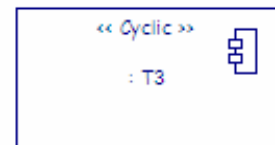
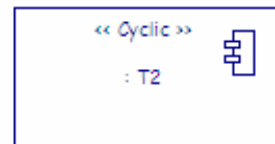
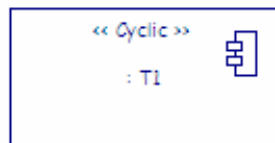
dissemination actions

- AADL related R&D projects tenders:
 - ITI (ESA R&D program): coupling Stood and Cheddar
 - RNTL (French R&D program): AADL for mobile robotics
 - ITEA (European R&D program): possible follow-on for COTRE
 - also a contribution to some ASSERT actions
- AADL focused presentations
 - SEE ADL day, Paris, 4 Apr. 2005
 - SSTC conference, Salt Lake City, 18-21 Apr. 2005
 - LSIS seminar, Aix en Provence, 28 Apr. 2005
 - DASIA conference, Edinburgh, 30 Apr. – 2 June 2005
 - France Telecom UML club, Lannion, 16 June 2005
 - Ada Europe conference, York, 20-24 June 2005
 - SigAda conference, Atlanta, 14-17 Nov. 2005
- current Stood-AADL tool evaluations
 - Industry: MBDA (F), Thales (F), SciSyst (UK), US Army (USA)
 - Universities (UBO Brest, ENST Paris, LAAS Toulouse, UPM Madrid)

AADL performance analysis with Cheddar (1/5)

- **Cheddar provides services to perform performance analysis:**
 - Schedulability analysis
 - Memory footprint analysis (i.e. shared buffers)
- **AADL Cheddar's services/extensions:**
 - Built with Ocarina (Ada95 AADL Parser, ENST Paris).
 - AADL threads analysis with real time scheduling tools.
 - Perform AADL event data port memory requirement analysis.
 - Properties extension in order to perform specific real time scheduling analysis (task dependencies, POSIX 1003.b scheduling, ...).

AADL performance analysis with Cheddar : real time scheduling (2/5)



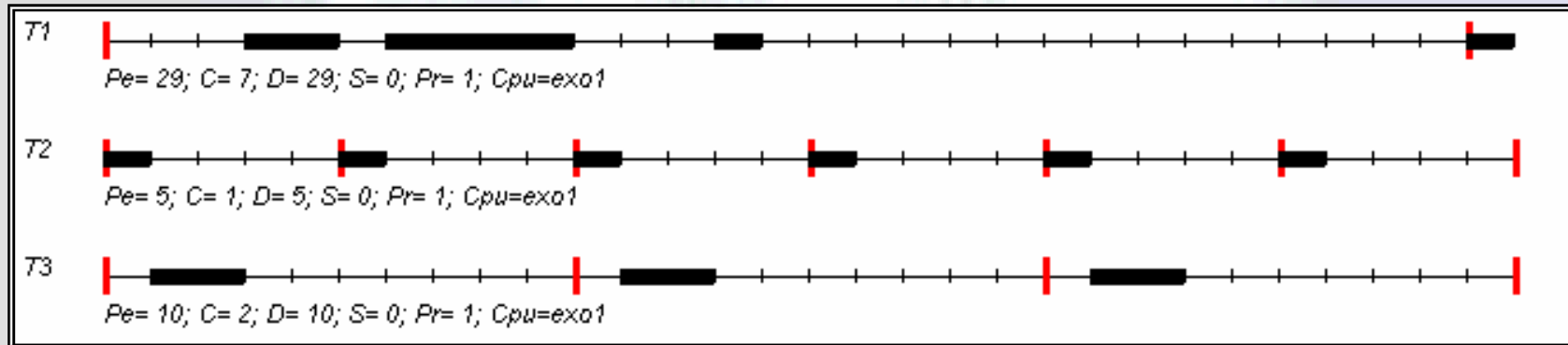
```
PROCESS IMPLEMENTATION schedulability.others
SUBCOMPONENTS
  T1 : THREAD T1;
  T2 : THREAD T2;
  T3 : THREAD T3;
END schedulability.others;
```

```
THREAD T1
PROPERTIES
  Dispatch_Protocol => periodic;
  Period => 29;
  Deadline => 29;
  Compute_Execution_Time => 7..7;
END T1;
```

```
THREAD T2
PROPERTIES
  Dispatch_Protocol => periodic;
  Period => 5;
  Deadline => 5;
  Compute_Execution_Time => 1..1;
END T2;
```

```
THREAD T3
PROPERTIES
  Dispatch_Protocol => periodic;
  Period => 10;
  Deadline => 10;
  Compute_Execution_Time => 2..2;
END T3;
```

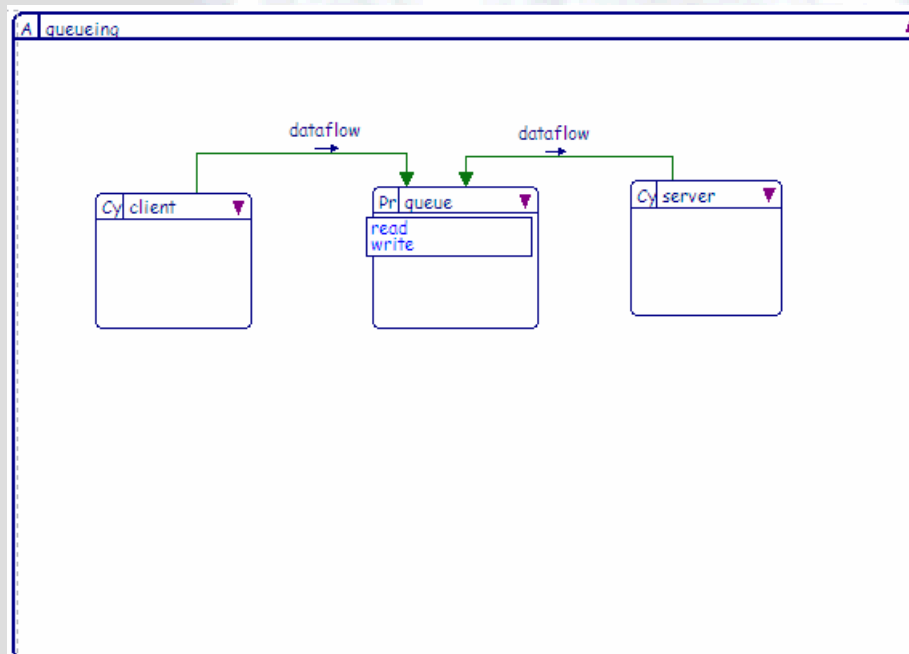
AADL performance analysis with Cheddar : real time scheduling (3/5)



- Real time scheduling** : periodic task (period, capacity, deadline) scheduled with schedulers such as Rate Monotonic (assign high priority to smallest period task). Feasibility test such as :

$$\sum_{i=1}^n \frac{C_i}{P_i} \leq n(2^{1/n} - 1) \approx 69\%$$
- Cheddar's real time scheduling services:**
 - Basic schedulers and task models (EDF, RM, LLF ..., periodic/apperiodic tasks).
 - Simulation tools and feasibility tests (based on processor utilization factor and task worst case response time).
 - User defined Extensions (scheduler/task) to model specific systems.

AADL performance analysis with Cheddar : queueing systems (4/5)



```

PROCESS queueing
END queueing;

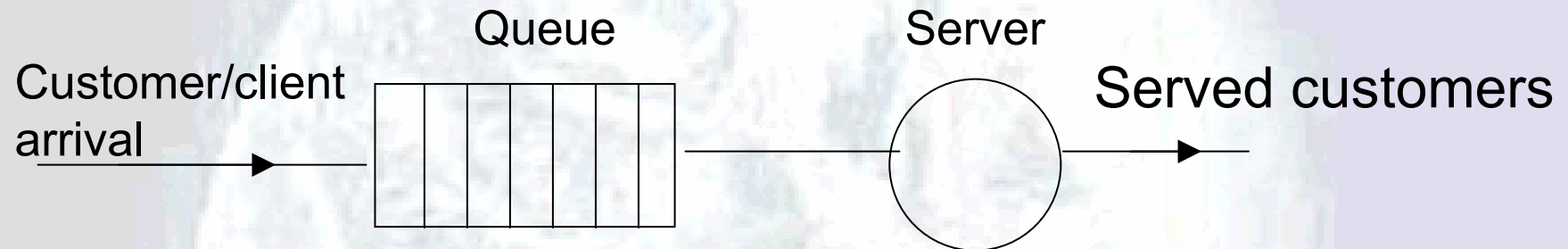
PROCESS IMPLEMENTATION queueing.others
SUBCOMPONENTS
  client : THREAD client;
  server_0 : THREAD server_0;
  queue : DATA queue;
CONNECTIONS
  DATA ACCESS queue -> client.queue;
  DATA ACCESS queue -> server_0.queue;
END queueing.others;

THREAD client
FEATURES
  queue : REQUIRES DATA ACCESS queue;
PROPERTIES
  Dispatch_Protocol => periodic;
  Compute_Entrypoint => thread;
END client;

THREAD server_0
FEATURES
  queue : REQUIRES DATA ACCESS queue;
PROPERTIES
  Dispatch_Protocol => periodic;
  Compute_Entrypoint => thread;
END server_0;

DATA queue
FEATURES
  read : SUBPROGRAM read;
  write : SUBPROGRAM write;
END queue;
  
```

AADL performance analysis with Cheddar : queueing systems (5/5)



- **Queueing systems :**
 - Assume a given customer/client arrival rate and a given customer service rate.
 - Compute customer waiting time and queue size.
- **Queueing system Cheddar's analysis tools :**
 - Classical queueing system criterion (M/M/1, M/D/1, M/G/1).
 - P/P/1, M/P/1 queueing system : worst case and average case analysis which take real time scheduling behavior into account (periodic task wake up time, task scheduling order, ...).